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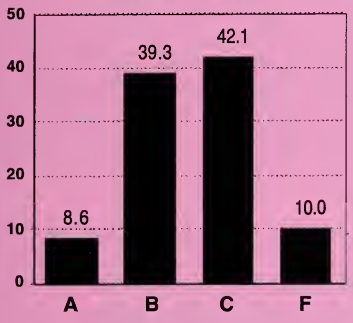
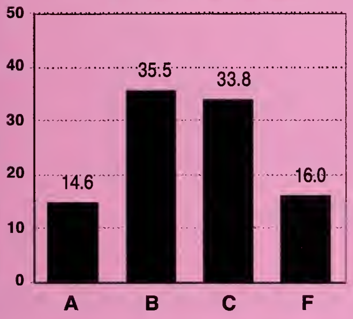
Science 30

Diploma Examination Results
Examiners' Report for January 1996

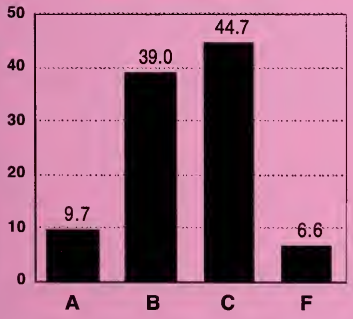
School-Awarded Mark



Diploma Examination Mark



Final Course Mark



The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the January 1996 administration of the Science 30 Diploma Examination. This information is most helpful when used with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results is published each year.

Description of the Examination

The Science 30 Diploma Examination consists of 44 multiple-choice questions worth 55%, 12 numerical-response questions worth 15%, and two written-response questions, each worth 15% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 349 students in Alberta who wrote the January 1996 examination.

- 93.4% of these students achieved the acceptable standard (a final course mark of 50% or higher).
- 9.7% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Students showed good understanding of the course content. They performed well in graph interpretation and in solving single-step problems that required calculations. They demonstrated a good understanding of the sources of pollution and the effects of pollution on the environment.

Students have shown a steady improvement in communication skills from the first field tests in 1994 to the written-response questions on the January 1996 Diploma Examination. The majority of students are now able to ascertain what the question is asking and can present a well-organized answer that contains specific examples to support their opinions.

Students experienced difficulty in solving multistep problems, such as titration calculations. They also have difficulty in constructing a suitable problem or hypothesis that is specific to a given study and in identifying nuclear reaction types and their applications.

Approximately 48.1% of the students who wrote the examination were females. Of these, about 81.0% achieved the acceptable standard on the examination, compared with 86.7% of the male population. Approximately 14.9% of the female population achieved the standard of excellence, compared with 14.4% of the male population. The average examination mark achieved by the female population was 62.7%, while the male population achieved an average mark of 65.1%.

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Provincial Averages

- The average school-awarded mark was 64.0%.
- The average diploma examination mark was 63.9%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 64.4%.

Results and Examiners' Comments

This examination has a balance of question types and difficulties. It is designed so that students capable of achieving the acceptable standard will obtain a mark of 50% or higher, and students achieving the standard of excellence will obtain a mark of 80% or higher.

In the following table, diploma examination questions are classified by question type: multiple choice (MC), numerical response (NR), and written response (WR). The column labelled "Key" indicates the correct response for multiple-choice and numerical-response questions. For numerical-response questions, a limited range of answers was accepted as being equivalent to the correct answer. For multiple-choice and numerical-response questions, the "Difficulty" indicates the proportion (out of 1) of students answering the question correctly. For written-response questions, the "Difficulty" is the mean score achieved by students who wrote the examination.

Questions are also classified by general learner expectations. Even though some questions address more than one GLE, only one GLE was selected for the purpose of this report.

Knowledge:

GLE 1	Nervous, Circulatory, & Immune Systems
GLE 2	Genetics
GLE 3	Chemistry & the Environment
GLE 4	Gravitational, Electrical, & Magnetic Fields
GLE 5	Astronomy & the Electromagnetic Spectrum
GLE 6	The Production & Use of Energy

Skills:

SPSC	Scientific Process Skills and Communication Skills

Science, Technology, Society:

STS	Connections Among Science, Technology, & Society

Blueprint

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPSC	STS
NR1	3.2	0.619			√				√	√
MC1	B	0.418			√				√	
MC2	C	0.596				√				√
MC3	C	0.888			√					√
MC4	B	0.473			√				√	
MC5	B	0.636			√				√	√
MC6	C	0.728			√					√
NR2	0.16	0.129			√				√	
MC7	A	0.777			√					√
MC8	A	0.865			√					√
MC9	B	0.728			√					√
MC10	A	0.923			√					√
MC11	B	0.716						√	√	√
MC12	A	0.619						√		
MC13	C	0.539						√		√
MC14	C	0.602						√		√
MC15	B	0.728						√		√
MC16	D	0.742						√		√
MC17	D	0.834						√		√
NR3	3412	0.699			√					
NR4	3412	0.427						√		√
MC18	A	0.877				√				√
MC19	C	0.481				√				√
NR5	1.16	0.705				√			√	√

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Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPSC	STS
NR6	6.0	0.590				√			√	√
MC20	A	0.487					√			
MC21	B	0.874				√			√	√
MC22	A	0.665		√					√	
MC23	D	0.461		√						
MC24	B	0.854	√							
MC25	B	0.668		√						
MC26	D	0.940	√						√	
MC27	D	0.771	√						√	
MC28	A	0.782	√							
MC29	B	0.848	√							
NR7	3241	0.496	√							
MC30	A	0.731			√					
MC31	B	0.579						√		√
MC32	C	0.567					√			√
MC33	A	0.527	√							√
MC34	A	0.777	√							
MC35	D	0.610					√			√
NR8	2134	0.487	√							
NR9	2314	0.521	√							
NR10	2.55	0.805				√			√	√
MC36	A	0.842						√		√
MC37	C	0.398				√			√	
NR11	14.1	0.840				√				√
NR12	6.73	0.596					√		√	
MC38	B	0.533					√		√	√
MC39	B	0.650					√			
MC40	C	0.762					√			
MC41	B	0.782					√			√
MC42	B	0.501					√			√
MC43	A	0.553					√			
MC44	A	0.610					√			
WR1		0.575							√	
WR2		0.585								√

btest: Multiple Choice and Numerical Response

hen analyzing detailed results, please bear in mind at subtest results **cannot** be directly compared. esults are in average raw scores.

Multiple choice and numerical response: 36.9 out of 56

General Learner Expectations

GLE 1	Nervous, Circulatory, & Immune Systems	7.0	out of	10
GLE 2	Genetics	1.8	out of	3
GLE 3	Chemistry & the Environment	8.6	out of	13
GLE 4	Gravitational, Electrical & Magnetic Fields	6.2	out of	9
GLE 5	Astronomy & the Electromagnetic Spectrum	6.7	out of	11
GLE 6	The Production & Use of Energy	6.6	out of	10
Skills		17.0	out of	28
STS		28.7	out of	43

Multiple choice: 29.9 out of 44

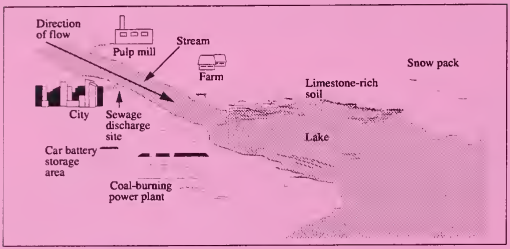
Numerical response: 6.9 out of 12

Subtest: Written Response

Results are in average raw scores.

- Written Response: 14.1 out of 24
- Question 1: 6.9 out of 12
- Question 2: 7.0 out of 12

An environmental technician conducted a study in the area shown in the diagram.



Numerical Response

1. The technician collected a sample of snow and determined the pH to be 5.50. The hydronium ion concentration $[H_3O^+_{(aq)}]$ of this sample was ________ × 10^{-6} mol/L.

(Round and record your answer to two digits on the answer sheet.)

Answer: 3.2

Numerical Response

2. The technician performed a titration to determine the concentration of 27.0 mL of a $H_3O^+_{(aq)}$ solution found at the car battery storage site. The technician added a solution of 0.240 mol/L $NaOH_{(aq)}$ to the acid until the bromothymol blue indicator changed from yellow to blue.

Initial volume of base = 25.80 mL
Final volume of base = 7.80 mL

The data from the experiment indicate that the concentration of the H_3O^+ was ________ mol/L.

(Round and record your answer to three digits on the answer sheet.)

Answer: 0.16

Numerical-response question 1 is an example of a question that tests the ability of a student to apply a formula from the data booklet to solve a single-step problem. Numerical-response questions 5, 10, 11, and 12 test the same skill but address different areas of the *Program of Studies*. Student performance on this type o question has improved from about a 25% success rate in 1994 field tests to a 60% to 85% success rate on the January 1996 Diploma Examination.

Of the students who wrote the examination, 61.9% were able to find the hydronium ion concentration $[H_3O^+]$ from the pH. Of the students achieving the standard of excellence, 79.4% were successful on this question. Of the students achieving the acceptable standard but not the standard of excellence, 65.3% answered the question correctly.

Numerical-response question 2 required students to calculate the volume of a base used in a titration and then use their answer to determine the concentration of a known volume of acid. The success rate on this type of question has been consistent at about 16% since the 199 field tests. The low success rate probably reflects the short period of time students in Science 30 have to practise these skills. Only 12.9% of all students answered the question correctly, with only 50.0% of those who achieved the standard of excellence answerin correctly. Of the students who achieved the acceptable standard but not the standard of excellence, only 13.8% answered the question correctly, and none of those who did not achieve the acceptable standard answered correctly.

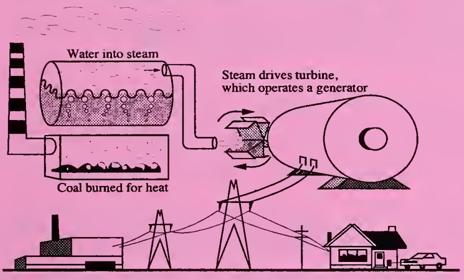
The CANDU nuclear reactor, which is manufactured in Canada, provides electrical power through nuclear fission. The difference between nuclear fission and nuclear fusion is that

- •A. fission involves splitting of atomic nuclei, while fusion involves joining of atomic nuclei
- B. fusion involves splitting of atomic nuclei, while fission involves joining of atomic nuclei
- C. fission releases energy from atomic nuclei, whereas fusion absorbs energy into atomic nuclei
- D. fusion releases energy from atomic nuclei, whereas fission absorbs energy into atomic nuclei

Which equation represents a balanced reaction that takes place in a nuclear fission reactor?

- A. ${}^{2}_{1}\mathrm{H} + {}^{2}_{1}\mathrm{H} \rightarrow {}^{3}_{2}\mathrm{He}$
- B. ${}^{2}_{1}\mathrm{H} + {}^{2}_{1}\mathrm{H} \rightarrow {}^{3}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n}$
- •C. ${}^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{141}_{56}\mathrm{Ba} + {}^{92}_{36}\mathrm{Kr} + 3\,{}^{1}_{0}\mathrm{n}$
- D. ${}^{235}_{92}\mathrm{U} + {}^{1}_{1}\mathrm{p} \rightarrow {}^{141}_{56}\mathrm{Ba} + {}^{92}_{36}\mathrm{Kr} + 3\,{}^{1}_{1}\mathrm{p}$

Production of Electricity from Coal



Electricity transmitted along towers and delivered to homes and industry

umerical Response

Provide the sequence of energy forms that occur when coal is burned to produce electricity.

1	mechanical	3	chemical
2	electrical	4	thermal (heat)

Answer: _____ to _____ to _____ to _____

(Record all four digits on the answer sheet.)

Answer: 3412

Multiple-choice questions 12 and 13 test students' knowledge about the nature of nuclear reactions and their use in nuclear reactors. On question 12, 15.2% of the students chose B, indicating that they did not know the difference between fission and fusion reactions. By choosing C or D (22.9%), students demonstrated that they did not know that both fission and fusion reactions release energy. Of all students, 61.9% answered question 12 correctly, with 91.2% of those who achieved the standard of excellence answering correctly. Of the students who achieved the acceptable standard but not the standard of excellence, 65.6% answered the question correctly, and only 8.7% of those who did not achieve the acceptable standard answered correctly.

By choosing A or B for question 13 (37.5%), students indicated that they thought a hydrogen fusion reaction is used in fission reactors. The CANDU reactor was given as an additional hint in the previous question. Of the 62.5% who recognized uranium as a reactant in a fission reactor, 8.6% chose D, indicating that they were unable to recognize an unbalanced nuclear reaction. Of all students, 53.9% answered question 13 correctly, with 79.4% of those who achieved the standard of excellence answering correctly. Of the students who achieved the acceptable standard but not the standard of excellence, only 55.5% answered the question correctly, and only 30.4% of those who did not achieve the acceptable standard answered correctly.

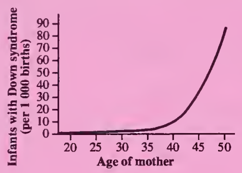
Numerical-response question 4 required students to identify the type of energy present in coal as chemical, then to list the conversion of chemical to thermal, to mechanical, and finally to electrical energy. Of all students, 52.1% did **not** list chemical as the first form of energy, 90.6% listed 4, 1, 2 in order, demonstrating that they understood this sequence of energy conversions. Of all students, 42.7% answered the question correctly, with 85.3% of those who achieved the standard of excellence answering correctly. Of the students who achieved the acceptable standard but not the standard of excellence, only 44.2% answered the question correctly, and only 21.7% of those who did not achieve the acceptable standard answered correctly.

Down syndrome is a genetic disease. Its incidence in infants is related to the age of the parents. A 35-year-old woman was considering having a child. The doctor showed the woman the following data.

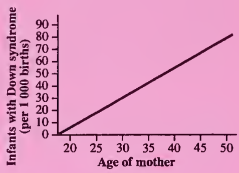
Age of mother (years)	Probability of having an infant with Down syndrome
20	1 in 1 925
25	1 in 1 205
30	1 in 855
35	1 in 365
40	1 in 110
45	1 in 32
50	1 in 12

22. The graph that correctly shows this data is

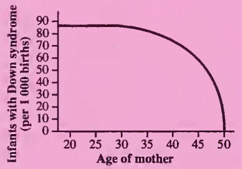
•**A.**



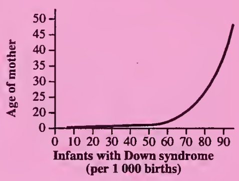
B.



C.

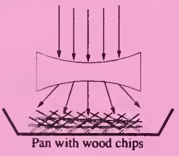


D.

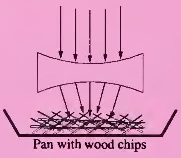


32. The campers used a pocket lens to start a campfire. Which diagram correctly represents this procedure?

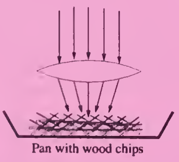
A.



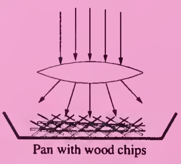
B.



•**C.**



D.



33. The campers took photographs of their campsite. Different light intensities require an adjustment to the aperture of a camera. The part of the eye that performs the same function as the aperture of a camera is the

•**A.** iris
B. lens
C. retina
D. cornea

For **multiple-choice question 22**, students could have chosen the correct graph by knowing the relationship o maternal age to the probability of having a Down syndrome baby. If they did not know this relationship, they could have deduced it from the table. Of all students, 8.3% chose D, indicating that they did not know that the manipulated variable belongs on the *x*-ax and the responding variable on the *y*-axis of a graph. O all students, 11.5% chose B, indicating that they knew that increased maternal age resulted in a greater probability of having babies with Down syndrome, but were unable to relate the data on the table to the graph. The 13.8% of students who chose C were probably confused by the ratios in the table. Of all students, 66.5% answered the question correctly, with 88.2% of those who achieved the standard of excellence answerin correctly. Of the students who achieved the acceptable standard but not the standard of excellence, 69.3% answered the question correctly, and 26.1% of those wh did not achieve the acceptable standard answered correctly.

Multiple-choice questions 32 and 33 integrate knowledge about the structure and function of the eye with an understanding of optical technologies.

Multiple-choice question 32 was answered correctly b only 56.7% of the students. By choosing B (28.7%), students indicated that they understood that the light rays must be focused but that they did not understand that a convex lens is the shape needed to focus the rays. Of all students, 56.7% answered the question correctly.

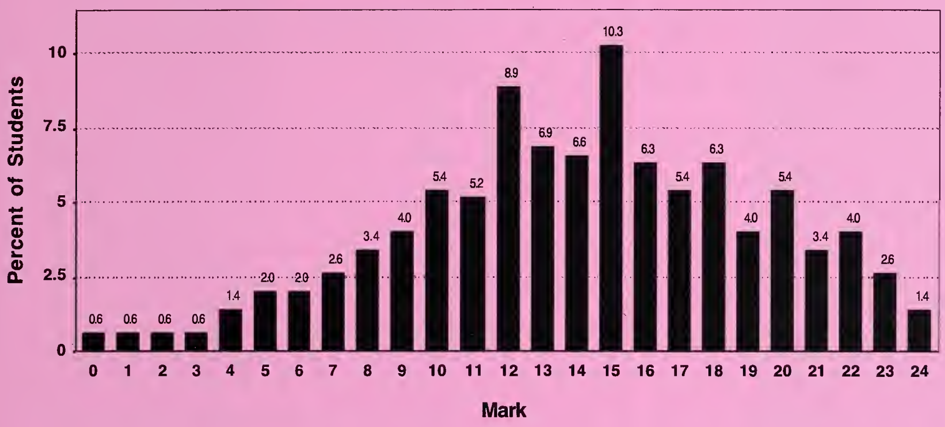
Multiple-choice question 33 required students to make the connection between the function of the aperture of a camera and the iris of the eye. Of all students, 52.7% answered the question correctly, with only 79.4% of those who achieved the standard of excellence answering correctly. Of the students who achieved the acceptable standard but not the standard of excellence, only 54.3% answered the question correctly, and only 30.4% of those who did not achieve the acceptable standard answered correctly.

Students generally perform poorly on questions that deal with the refraction and diffraction of light.

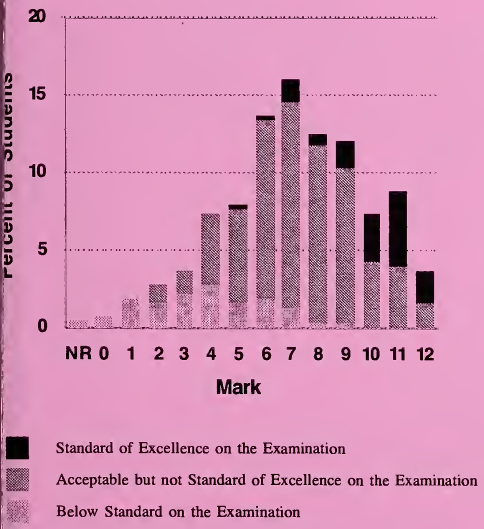
itten-Response Questions

formance on written-response questions has improved steadily from the beginning of field testing in uary 1994, where a large portion of students would not even attempt to answer the written-response stions. Of the students who wrote this examination, 2 students received no mark for both written-ponse questions, 71.6% received 12 marks or more out of 24, and 16.9% received 20 marks or more out 24. The average mark on the written-response questions was 14.1 out of 24 or 58.8%.

Distribution of Marks for Written Response



Distribution of Marks for Question 1



Question 1: This process-skill question, which related to a research study of the effects of dioxins and furans on the immune system of harbour seals, was attempted by almost all students (99.4%) who wrote the examination.

Part *a* required students to state a problem and hypothesis consistent with the study. Many students had difficulty constructing a problem that was specific to the study; for example, "What causes the seals to get diseases?" In this response, no mention was made of organochlorides, body mass, white blood cells, or cytotoxic T cells.

Since there is such a variance of what constitutes an acceptable hypothesis, the responses deemed acceptable were those that made a prediction that fit well with the study. Many hypotheses either did not conform to the study or did not include all aspects of the study; for example, "The polluted food they eat hurts the T cells."

In Part *b,* most students were able to outline important controlled variables for this study.

In Part *c*, most students were able to summarize the data as depicted by the three graphs. Many students failed to mention the data represented by the “Body Mass of Harbour Seals” graph. Some students recognized that the difference in body mass between the two graphs was insignificant.

Many students stated that the seals exposed to organochlorides would develop diseases and would respond by producing more white blood cells. A few students thought that the organochlorides were bein attacked by white blood cells.

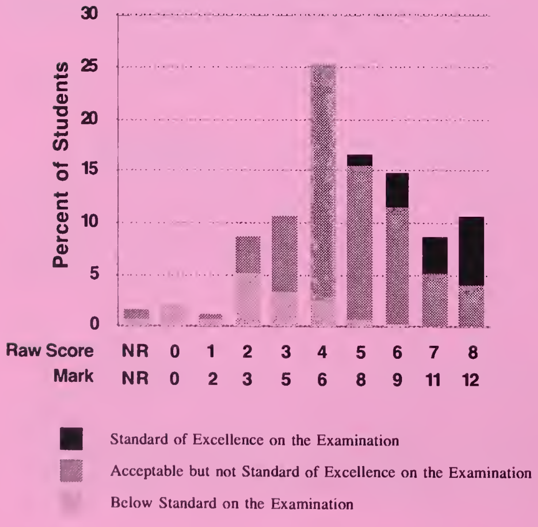
Most students stated that organochlorides decrease t ability of the cytotoxic T cells to function. Only a fe students recognized that a decrease in the ability of the cytotoxic T cells would result in an increase in th number of antigens and that this would cause the immune system to produce more white blood cells.

On this 12-mark question, the average mark was 6.9 or 57.5%. On this question, 69.3% of the student population achieved the acceptable standard and 18.1% of the student population achieved the standa of excellence.

Question 2: This question was attempted by 99.4% of students who wrote the examination. Most studen were able to identify and describe a renewable and a non-renewable energy source. Many students were able to describe the risks and benefits associated wit the energy sources. A few students used detailed descriptions and specific examples to clarify their descriptions.

On this 12-mark question, the average mark was 7.0 or 58.6%. On this question, 75.9% of the student population achieved the acceptable standard and 19.2% of the student population achieved the standa of excellence.

Distribution of Marks for Question 2



For further information, contact John Drader or Yvonne Johnson at the Student Evaluation Branch, 403-427-0010.

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